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ated, violent stage of the same phenomena. When the vortex currents become violent, watery liquid accumulates between the cleavage cells so that they are separated and henceforth develop separately to form a twin.

It is to be regretted that the excellent observations recorded do not bear more forcibly upon the hypothesis advanced.

PSYCHOLOGY.¹

Mental Development in the Child and the Race : Methods and Processes. BY JAMES MARK BALDWIN, M.A., PH.D., STUART PROFESSOR OF PSYCHOLOGY IN PRINCETON UNIVERSITY.²—Prof. Baldwin's latest book will prove of no less interest to the biologist than to the psychologist. There is a growing feeling that biology, the science of life at large, and psychology, the science of the inner life, since they deal with facts of the same order, must ultimately express these facts in essentially the same conceptions. To biology we must look for the most generalized expression of those conceptions; it will be the duty of the psychologist to apply them in his narrower field and to restate them with such additions and limitations as the facts demand. Yet, just because his field is the narrower, we may expect of him suggestions which will aid the biologist in his work. This is what Prof. Baldwin has undertaken to do. While studying imitation in the infant, he tells us, he was struck by the important part played by it in the development of the individual. This led him to read again "the literature of biological evolution with view to a possible synthesis of the current biological theory of organic adaptation with the doctrine of the infant's development," and this book is the outcome. It is full of original and suggestive material and I think I can do no better than give the readers of the *NATURALIST* a fairly complete outline of its contents.

The arrangement of the book is open to criticism. The first six chapters deal with certain special problems and are intended to develop inductively the fundamental conceptions of dynamogenesis

¹ This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

² Macmillan & Co., 1895. Price, 2.60.

and the circular reaction which underlie the entire book. These chapters, although of considerable intrinsic value, are superfluous so far as the main object of the book is concerned, in that their contributions to it might have been much more clearly put and in briefer compass. It is in the last chapter, on Suggestion, that the principal of dynamogenesis is most clearly stated: "The principle of contractility recognized in biology simply states that stimulations to living matter—the protoplasm of the higher vegetable and animal structures—if they take effect at all, tend to bring about movements or contractions in the mass of the organism. This is now also safely established as a phenomenon of consciousness—that every sensation or ingoing process tends to bring about action or outgoing process." (P. 166.) The movements thus produced may simply be repeated, thus forming a habit. But many of them "seem to beget new movements by a kind of adaptation of the organism—movements which are an evident improvement upon those which the organism has formerly accomplished." How is this done? This introduces us to the main problem of the book—that of Accommodation.

The answer is found in the Law of Excess. Of all the stimuli to which the organism is exposed some are advantageous. These heighten vitality and thereby increase the amount of motor reaction. In the case of advantageous stimuli the reaction is expansive, towards the source of stimulation, but the disadvantageous produce contractions, away from the source of stimulation. It is evident that the expansive movements are best fitted to secure the repetition of the stimulus, and the excessive discharge greatly increases this probability. If any one of these movements proves successful, there is a second excess discharge, but the second tends to pass out by the channels of the successful movement. This gives us the nucleus of a habit. The law that advantageous stimuli produce expansive movements and disadvantageous contraction is doubtless due to natural selection. (Pp. 199 et seqq.) The admission or denial of the inheritance of acquired traits would not affect this theory. And, since it represents selective reaction as part of the original endowment of life, and since this selective reaction is the organic analogue of pleasure and pain, we may say "that life began with consciousness, that is, with feelings of pleasure and pain. This position preserves the criterion of mind, making it also the criterion of life, and so assumes an absolute phylogenetic beginning of both life and mind in one." (P. 213.) From the preceding discussion the relation of Habit and Accommodation comes clearly to view. "Habit expresses the tendency

of the organism to secure and to retain its vital stimulus," (P. 216) while by Accommodation the organism "learns new adjustments simply by exercising the movements which it already has, its habits, in a heightened or excessive way."

Prof. Baldwin then undertakes to apply these principles to the explanation of the phenomena of life, especially of human life. The first problem attacked is the origin of motor attitudes and expressions, which includes the theory of emotion. In the psychophysics of emotion in general the three factors, Dynamogenesis, Habit and Accommodation are clearly traceable. By the first every element of content must have its motor expression, but as no two contents are ever exactly the same, our reactions are constantly being modified by new motor elements. Habit, it is true, tends to diminish the amount of consciousness found in the reaction, but on the other hand, by increasing the total motor disturbance, it increases the consciousness of movement, which is a chief element in all emotion. It is, therefore, a factor in the genesis of emotion. By virtue of Accommodation such of the new elements contributed by Dynamogenesis as are useful to the organism get associated with and modify the old, thus increasing the total content of the emotional state. To this must be added the pleasures and pains of Attention, itself, as later to be shown, a form of motor accommodation. When we come to examine the special forms of emotion we find that the laws of expression formulated by other writers, such as the principles of antagonism, of direct motor discharge and of analogous feeling stimuli are readily explained as varying expressions of the laws above given. But we must note that in the individual the acquisition of emotional expression depends largely upon imitation.

Returning now to the fundamental type of reaction, we find that it involves: Stimulus—increased vitality—excess discharge ("random movements") towards source of stimulation—accidental securing of the beneficial stimulus by some one of these movements, thereby tending to make the same reaction easier—repetition of the process. This is best described as a circular reaction, since it tends to repeat itself, and as its nearest conscious analogue is found in imitation the whole class may be termed imitative. In the simplest form, as above described, it may be termed organic imitation. An examination of the responses to stimulations found in the lower forms of life, both animal and vegetable, shows that reactions of this type are coextensive with life itself. But in the higher forms, in which consciousness has been developed, the reaction assumes new forms. The stimulus produces

conscious experience, and its repetition repeats that experience. But the experience may also be repeated in the form of an *idea* without the occurrence of the stimulus, and this idea may take the place of the stimulus and produce the reaction. This is termed conscious imitation, and is the germ of voluntary action. Furthermore these ideas, or copies, may be associated with one another, so that any one tends to awaken others and with them their appropriate reactions. Thus all the higher functions originate from and involve the lower. Sometimes, by the principle of lapsed links, the true stimulus may disappear and the movement be produced, to all appearance, by one of the associative antecedents of the stimulus.

ASSIMILATION AND RECOGNITION.—The copy image may be so strong as to assimilate to itself the new experiences, their motor discharges uniting in one—this union in motor discharge is the basis of association by contiguity; association by similarity is found “when both of them, by association with a third have come to unite in a common discharge. The energy of the new presentation process finds itself drawn off in the channels of the old one which it resembles; the motor associations, therefore, and with them all the organic and mental elements stirred up by them, come to identify or unite the new content with the old.” (309.) Assimilation then is due to the tendency of a new sensory process to be drawn off into preformed motor reactions. Some of these reactions are directly useful. Others constitute a more special kind of motor reaction upon the mental content. This latter is attention. It consists of three factors. First, the grosser muscular strains in brow, scalp, etc.; second, the more special strains of sense accommodation; third, the still more special strains peculiar to the content in question. When a new experience is repeated, not only is it assimilated to the memory of the original experience, but the third factor in attention is facilitated; these two constitute what we call recognition. (P. 314.) Upon the first factor of attention depends the peculiar sense of “warmth” or “ownership;” it is due to the fact that the attention strains constitute a large part of the sense of self. Recognition is an advanced form of adjustment to environment and has been of great phylogenetic significance.

CONCEPTION AND THOUGHT.—The principles already developed furnish a basis for the evolution of the higher mental processes. Judgment, or the demand for identity, is the conscious representative of the irresistible tendency to act in one way upon a variety of experiences. Belief is the conscious representative of the assimilation of new to old tendencies to action. Conception and per-

ception arise together when new experiences are brought face to face with old memories to whose motor tendencies their own can be but partially assimilated. In so far as assimilation takes place the concept arises; in so far as it does not the respective contents are discriminated as particulars, and this discrimination is the function of perception. By the omission of certain motor reactions peculiar to the several occurrences of a common sensory content the latter is *abstracted*. Thus we see that the general or abstract "is not content at all. It is an attitude, an expectation, a motor tendency." (P. 330.) And when we recognize an object as belonging to a class, we mean that this object presents, in addition to the motor reactions peculiar to itself, motor reactions common to it and many other objects.

SYMPATHY is primarily due to imitation.—At times a new presentation is assimilated to memories of past experiences and thus awakens their emotional reactions—at others the sight of the emotional reaction in others provokes a similar reaction directly. To imitation the consciousness of self is also largely due. Its earliest form is found in a discrimination of persons as moving and especially interesting objects whose conduct at first admits of no exact calculation. This is the *projective* stage. The second stage is initiated by imitation of these projects; together with other bodily sensations the sense of effort then emerges and with it comes the vague consciousness of self as a *subject*. In the third stage the subjective elements thus gained are ascribed to the projects and they become *ejects* or persons like the subject. (Pp. 333 et seqq.)

THE ETHICAL FEELING originated in like manner—The child must accommodate himself to his environment, and especially to that part of his environment which we term the authority of others. But, as we have shown, one element of the self owes its origin to this very factor. Thus the intrinsic or habitual self tends to come in conflict with the self of accommodation and imitation. Later, from this external factor, is formed a "moral ideal of a possible, perfect, regular will taken over in me in which the personal and social self—my habits and my social calls—are brought completely into harmony; the sense of obligation in me in each case is a sense of lack of harmony—a sense of actual discrepancies in the various thoughts of self as my actions and tendencies give rise to others." (P. 345.)

The third form of imitation, which we may term plastic imitation, embraces those degenerated forms of reaction, which, having once been conscious, are now become secondarily automatic and subconscious. They fall under two classes; those that represent habitual

reactions and those that represent the imitative tendency itself become habitual. The first finds its expression in the community in conservatism; the second in liberalism.

VOLITION involves desire, deliberation and effort.—Desire consists of “(1) a pictured object suggesting associated experiences which it is not sufficient to realize, and (2) an incipient motor reaction which the pictured object stimulates but does not discharge.” (P. 368.) Thus the germs of desire are present whenever a nascent movement is inhibited, but it is only when the representative element is added that it becomes typical desire. As desire arises from inhibited reactions, so does deliberation arise from the competition of reactions by the addition of analogous representative elements. Effort arises upon the resolution of a state of deliberation.

In persistent imitation we have the earliest form of volition. The “copy” is given and provokes a movement which only partially reproduces it. The apprehension of the movement as actually performed now constitutes a momentum prompting its repetition, but the original “copy” still persists, prompting a slightly different movement—out of the competition of these two reactions is formed a third, from these three a fourth, and so on until the movement as performed and the persistent “copy” prompt to the same movement—that is until the movement is successful. The sense of effort is due, as above shown, to the co-ordination of two or more such reactive tendencies. Thus we find in volition “the point of meeting of two principles, Habit and Accommodation, and their common function.”

In the highest exhibition of reflective volition there is “no departure in type, however wide a departure it be in meaning and implications for philosophy—from the first organic reactions of organic life. Habit is formed in the face of suggestion through persistent imitation and volition, and Habit, made organic in character, is modified in turn by changed environment, which is reacted to by imitation and volition.” (P. 388.) Prof. Baldwin then proceeds to present a mass of special evidence for the doctrines above outlined from the early life of infants, from some experiments made on students, from the intimate relation of attention to voluntary movement, from the phenomena of partial or total aboulia, especially as found in hysteria, idiocy and the various disturbances of speech. This last is of especial interest but is too technical in character to be given in abstract. Then follows a chapter on the Mechanism of Revival and Internal Speech and Song of which the same may be said. It is intended to illustrate the application of the theory to detailed instances.

"ATTENTION is the mental function corresponding to the habitual motor coordination of the processes of heightened or excess discharge." This theory finds a further confirmation in two facts. First, since the excess discharge is the sole means of accommodation in the lower organisms, and attention the only one in consciousness, we must connect in theory the function of excess with that of attention. Second, the excess discharge is also the organic analogue of pleasure and pain; attention, then should be the seat of pleasure and pain. This we find to be the case, especially in the pleasures of emotional and intellectual life. Since attention is a motor phenomenon, and since by the law of Dynamogenesis the more intense sensation has the greater effect, we readily see why an intense sensation tends to attract attention, and why attention tends to increase the intensity of the content attended to. It follows (P. 468) that attention is not a single function—there are as many attentions as there are contents. This fact has escaped notice because in all states of attention there is a certain relatively constant element, viz.: tensions in brow, jaws, skin of head, etc. "The office of attention is that of fixing the content steadily on the sensory side, and at the same time of releasing the associated discharge movements on the motor side. It is a go-between between the copy imitated and the imitation which copies it and is, therefore, *the central and essential fact in all voluntary muscular control.*"

I have gone somewhat at length into the analysis of this book because it seems to me a most important contribution both to biology and psychology. It may be described as an attempt to express all forms of conscious experience, from the lowest to the highest, in terms of their motor concomitants. In a sense the attempt is strictly legitimate. All mental states have motor concomitants, and since motion is the most essential fact in the life of the organism, and moreover, since movements are often more easily studied and measured than their accompanying mental states, it may well be that from a study of movement we may get those architectonic conceptions which all psychologists seek, but which have not as yet been got from introspection. But in the effort one is apt to exaggerate the genetic importance of the motor element, to ignore certain definite laws which introspection reveals, and to rest content with a careless and inadequate analysis of the psychoses which are to be explained. Against a large part of Prof. Baldwin's book these charges may be brought, and I think they rob many of his expositions of all practical value. Yet the book is full of acute observation and insight; one feels upon first reading it that he has here a mass of material of very unequal value, care-

lessly thrown together, whose exact value will come to view only after careful thought and study. Especially does it seem that the conception of the circular reaction and its genetic importance in the individual will remain a permanent acquisition of psychology.

ANTHROPOLOGY.¹

Surprising Discovery of Ancient Rope and Netting in Southwestern Florida.—Lieutenant-Colonel C. D. Demford, late of the English army, has found in the recent months, a piece of well-preserved rope, a mass of string woven into the meshes of a net and several artificially shaped wooden billets, from two to three feet deep, in a deposit of soft, black mud, in one of the tide-water sea lagoons near Punta Rasso. These objects were associated with a necklace of shells and a well-preserved wooden dish, evidently of Indian make, and lay at a spot flooded daily by the salt tide, and encircled by one of the narrow ridges of oyster shells, now familiar to students, made by Indians, who feasted on molluscs at the spot. Here, as at other places on the west coast, the shells seemed to have been so arranged upon the low margins of the lagoons as to form small canals and water basins, where canoes could easily pass shoreward, and land on hard bottom when the tides were favorable. As far as I know, no such discovery as this of Lieutenant-Colonel Demford's has come to the notice of students in Florida before, but it remains to be proven, beyond reasonable doubt, that none of the objects, which rested on the shell bottom in the middle of the basin, and completely under the mud, worked their way down in recent times. Nevertheless, experience in digging out the bottom of drained lakes in Switzerland has shown us the effect of mud in preserving perishable objects of human make for long periods of time, and there is no reason why submarine deposits may not restore to us lost details of the past here as well as there. This brilliant and original work in Florida, directing investigation into a new channel, leaves us to wonder why no one thought of it before. The discoverer, while carrying many of the objects found to England, has kindly deposited a series of them at the Museum of Archæology of the University of Pennsylvania, to whose

¹ This department is edited by H. C. Mercer, University of Pennsylvania.